

We Claim:

1. In a wireless receiver wherein a radio frequency signal is received, downconverted and processed into in-phase (I) and quadrature (Q) signal paths, a method of automatic gain control (AGC) comprising the steps of:

- (a) at a specified stage in an I/Q baseband strip containing multiple automatic gain control (AGC) stages, each of said AGC stages having locally generated control signals associated therewith:
 - i. detecting respective I and Q output signals received from respective I and Q variable gain amplifiers (VGAs) associated with said specified AGC stage;
 - ii. digitizing said detected I and Q signals;
 - iii. adjusting with said associated control signal said respective I and Q VGAs for differences between said detected I and Q output signals and a reference signal; and
- (b) repeating step (a) through each AGC stage.

2. The method of claim 1 wherein the step of detecting further comprises:

- (a) passing said respective I and Q output signals through respective high pass filters (HPFs);
- (b) rectifying said respective I and Q filtered output signals;
- (c) adding said respective I and Q filtered output signals in an operational amplifier; and
- (d) passing said added I and Q filtered output signal through a low pass filter (LPF).

3. The method of claim 1 wherein the step of digitizing further comprises:

- (a) receiving in an analogue to digital converter (ADC) said added low pass filtered I and Q signal;
- (b) comparing said received signals to a reference signal; and

- (c) generating digital up/down and count/hold control signals.
4. The method of claim 3 wherein said step of comparing further comprises using a multi-level comparator and a logic circuit to generate said digital up/down and count/hold control signals.
5. The method of claim 4 wherein the step of adjusting further comprises:
- (a) receiving in an up/down counter said up/down and count/hold control signals; and
 - (b) setting the gains of respective I and Q variable gain amplifiers (VGAs).
6. The method of claim 5 wherein the step of setting further comprises:
- (a) if said I and Q filtered output signals fall outside a predefined boundary, modifying the gains of said respective I and Q VGAs until a desired I/Q output signal is achieved;
 - (b) else, maintaining said respective I and Q VGA settings.
7. The method of claim 6 wherein the step of modifying comprises adjusting said respective I and Q VGAs at a fast rate if said detected I/Q output signal is beyond a first predefined range or at a slow rate if said detected I/Q output signal is beyond a second predefined range.
8. The method of claim 6 wherein the step of modifying comprises adjusting said respective I and Q VGAs at a large magnitude if said detected I/Q output signal is beyond a first predefined range or at a small magnitude if said detected I/Q output signal is beyond a second predefined range.
9. In a wireless receiver wherein a radio frequency signal is received, downconverted and processed into in-phase (I) and quadrature (Q) signal paths, an automatic gain control (AGC) circuit comprising an I/Q baseband strip comprising multiple AGC stages wherein each of said AGC stages comprises:

- (a) respective I and Q variable gain amplifiers (VGAs);
 - (b) a detector for detecting respective I and Q output signals received from said respective I and Q variable gain amplifiers (VGAs);
 - (c) an analogue to digital converter (ADC) for converting said detected I and Q output signals; and
 - (d) a digital engine for digitally adjusting said respective I and Q variable gain amplifiers (VGAs) for differences between said detected I and Q output signals and a reference signal.
10. The automatic gain control circuit of claim 9 wherein said detector comprises:
- i. respective I and Q high pass filters (HPFs) for removing direct current (DC) offsets from said respective I and Q output signals;
 - ii. a rectifier communicating with said respective I and Q HPFs for changing said respective filtered I and Q output signals from alternating current (AC) to direct current (DC);
 - iii. an operational amplifier (Op-amp) communicating with said rectifier for adding said filtered I and Q output signals; and
 - iv. a low pass filter (LPF) communicating with said Op-amp for filtering said added I and Q output signals.
11. The automatic gain control circuit of claim 10 wherein said ADC comprises a multi-level comparator and a logic circuit.
12. The automatic gain control circuit of claim 11 wherein the number of levels in said multi-level comparator is at least four.
13. The automatic gain control circuit of claim 12 wherein said digital engine comprises an up/down counter for setting gains associated with said respective I and Q variable gain amplifiers (VGAs).

14. In a wireless receiver wherein a radio frequency signal is received, downconverted and processed into in-phase (I) and quadrature (Q) signal paths, an automatic gain control (AGC) circuit comprising an I/Q baseband strip comprising at least two AGC stages wherein each of said AGC stages comprises:

- (a) respective I and Q variable gain amplifiers (VGAs); and
- (b) a closed feedback loop providing respective digital control signals to said respective I and Q variable gain amplifiers.

15. The automatic gain control circuit of claim 14 wherein said closed feedback loop comprises:

- i. a detector for detecting respective I and Q output signals received from said respective I and Q variable gain amplifiers (VGAs);
- ii. an analogue to digital converter (ADC) for converting said detected I and Q output signals; and
- iii. a digital engine for digitally adjusting said respective I and Q variable gain amplifiers (VGAs) for differences between said detected I and Q output signals and a reference signal.

16. The automatic gain control circuit of claim 15 wherein said closed feedback loop is positioned before said respective I and Q variable gain amplifiers (VGAs).

17. The automatic gain control circuit of claim 15 wherein said closed feedback loop is positioned after said respective I and Q variable gain amplifiers (VGAs).

18. In a wireless receiver wherein a radio frequency signal is received, downconverted and processed into in-phase (I) and quadrature (Q) signal paths, a method of automatic gain control (AGC) comprising, at a specified stage in an I/Q baseband strip containing at least two automatic gain control (AGC) stages, each of said AGC stages having respective I and Q variable gain amplifiers (VGAs) associated therewith, providing locally generated respective I and Q digital control signals to said respective I and Q VGAs through a closed feedback loop associated with said specified AGC stage.

19. The method of claim 19 wherein the step of providing comprises:
- i. detecting respective I and Q output signals received from said respective I and Q variable gain amplifiers (VGAs) ;
 - ii. digitizing said detected I and Q signals; and
 - iii. adjusting with said associated control signal said respective I and Q VGAs for differences between said detected I and Q output signals and a reference signal.